

ENGINEERING NOTE**LH 20 01****M8061****1 of 3**

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02/17/02*MAG*Program - Project - Job:**US - LHC DFBX
DFBX LIFTING**Title:**Hoist Ring Analysis**Safety Case Number: 01-011**INTRODUCTION**

This note defines the criteria for selecting the hoist rings to be used to lift the DFBX box assembly. The rings are selected based on the estimated weight of the DFBX. The weld bosses which the rings are mounted to are also checked for stress levels under the lifting load.

DISCUSSION

The computed weight of a completely assembled DFBX including 15% contingency is 6.5 tons (5900 kg). Using this value, a hoist ring was selected assuming the weight of the assembly is shared among three of the four rings. The lifting fixture slings are angled toward the center of the box. From Engineering Note, "Stress Analysis of LHC DFBX Lifting Fixture", M8046, the larger sling angle of 54.4° increases the load seen at the hoist ring by a factor of 1.23. Dimensions and technical data for the ring are listed in Table I in the Appendix. The data are in metric units. The hoist ring will use the 2200-kg rated ring, part number 24020 with a 5:1 safety factor.

The boss for each of the lifting eyes (LBNL drawing 25I181) is 4.5 inches in diameter and 1.33 inches thick. Fillet welds are used to attach the bosses to the end plates of the DFBX (LBNL drawings 25I129 and 25I133). See Figure 1.

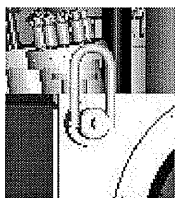


Figure 1. Close-up view of typical hoist ring and welded boss on DFBX vacuum box end plate.

RESULTS

Checking the factor of safety for the 2200-kg rated hoist ring,

$$F. S. = 2200(5)/2422 = 4.5$$

Checking shear loading on the fillet weld for a round boss:

$$\tau = F / (.707h\pi d/2), \text{ where } \begin{array}{l} \tau = \text{shear stress, psi} \\ F = \text{shear load, lbs (assume three bosses share load)} \\ h = \text{weld height, in.} \\ d = \text{boss diameter, in.} \end{array}$$

$$\tau = 4333(1.23) / \{ (.707)(.38)(\pi)(4.5/2) \} = 2805 \text{ psi}$$

S

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The equivalent allowable for the boss weld is calculated using the recommended factor applied to the allowable yield for the material.

S_y for 304L stainless = 25000 psi

For shear loading of a fillet weld¹, $S = 0.4S_y$ (p. 275, Shigley)

This gives a safety factor of

$$F. S. = 25000(.4)/2805 = 3.5$$

CONCLUSION

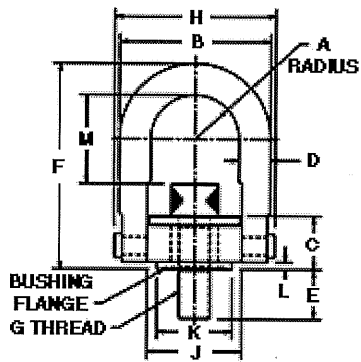
The safety factor, 4.5, for the hoist ring is sufficient for lifting the box assuming a smooth and gradual lifting movement as there is already a significant margin of safety included in the hoist ring rating. The weld boss safety factor is acceptable at 3.5.

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APPENDIX

Hoist ring data.

¹ J.E. Shigley, Mechanical Engineering Design, p275, McGraw-Hill, 1963.

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Part No.	Rated Load (Kg)	A	B	C	D	E	F	G	H	J	K	L	M	TL* (Nm)	WT (Kg)
24008	400	10.9	40.9	18.0	9.5	17	67.8	M8x1.25	46.7	25.4	19.1	4.3	32.1	9.5	0.14
24010	450	10.9	40.9	18.0	9.5	17	67.8	M10x1.5	46.7	25.4	19.1	4.3	30.2	16.0	0.14
24012	1050	22.4	82.5	31.0	19.0	19	121.4	M12x1.75	89.4	50.5	38.0	4.1	59.4	37.0	1.05
24016	1900	22.4	82.5	31.0	19.0	24	121.4	M16x2.0	89.4	50.5	38.0	4.1	55.4	80.0	1.11
24020	2200	22.4	82.5	31.0	19.0	30	121.4	M20x2.5	89.4	50.5	38.0	4.1	51.4	135.0	1.16
24022	3000	35.6	121.2	43.4	25.4	29	165.8	M20x2.5	130.5	76.2	58.7	6.1	77.0	135.0	3.06
24024	4200	35.6	121.2	43.4	25.4	34	165.8	M24x3.0	130.5	76.2	58.7	6.1	73.0	311.0	3.18
24030	4500	35.6	121.2	43.4	25.4	54	165.8	M30x3.5	130.5	76.2	58.7	6.1	67.0	311.0	3.30
24040	7000	44.5	152.4	53.6	31.8	46	221.7	M30x3.5	165.1	95.5	81.3	8.9	106.3	637.2	6.36
24042	7000	44.5	152.4	53.6	31.8	66	221.7	M30x3.5	165.1	95.5	81.3	8.9	106.3	637.2	6.70
24050	11000	57.2	203.2	71.4	44.5	69	316.7	M36x4.0	217.2	123.7	106.7	11.9	164.8	1085.5	15.34
24052	12500	57.2	203.2	71.4	44.5	79	316.7	M42x4.5	217.2	123.7	106.7	11.9	158.8	1085.5	15.91
24054	13500	57.2	203.2	71.4	44.5	79	316.7	M48x5.0	217.2	123.7	106.7	11.9	152.8	1085.5	16.36
24060	22000	76.2	266.7	104.0	57.2	102	428.5	M64x6.0	296.4	165.6	146.1	28.4	203.3	2847.5	39.77